

# **CHEWY CANDY ANALOGUE, METHOD OF MAKING, AND COMPOSITE ICE CONFECTIONS CONTAINING SAME**

## **TECHNICAL FIELD**

5 The present invention is directed to chewy candy analogues that are compatible with ice confectionery products, particularly in terms of the process, storage and consumption conditions of ice confectionery products. Also to methods of making such chewy candy analogues; to methods of  
10 combining such chewy candy analogues with ice confections; and to combination ice confectionery products that include such chewy candy analogues.

## **BACKGROUND OF THE INVENTION**

15 Chewy candy or sugar confectionery products have been known throughout the ages and these satisfy both nutritional, for example energy, and hedonic needs, especially sweetness, of humans. They include items such as certain boiled sugar sweets, caramels, toffees, fudges, gums, jellies, licorice paste, cream paste, aerated confections such as marshmallow and nougat,  
20 various tablets, lozenges, chewing gums, fondants, marzipans, and the like, and combinations thereof.

A key feature of such materials is the need to be stable microbiologically, as well as physically, above freezing and particularly at ambient conditions, and this involves the inclusion of relatively high levels of  
25 sugar or sugars and other soluble solid ingredients for preservation reasons. High levels of such ingredients increases the hydrophilic properties, *i.e.*, lowers the equilibrium relative humidity of such articles making them unsuitable for combination with ice confections.

Additionally, because of the high sugar(s) and other total soluble solids  
30 present in prior art chewy candy materials, they have a requirement to be processed and formed or shaped at high temperatures. Such high temperatures are generally anathema to routine ice confection processing and forming.

Further, such chewy candy articles are also normally stored and consumed at ambient conditions. This often results in different textures than if  
35 they had been stored with ice confections and consumed at normal ice confection consumption temperatures. If regular chewy candy articles are stored and consumed at the frozen temperatures of ice confections, they are unacceptably hard and gluey.

In these respects, prior art chewy candy or sugar confectionery is incompatible with ice confections and so there is a need for analogues of such products which are so compatible.

Ice confections are also well known. They include ice cream bulk products, novelties, *i.e.*, bar and stick items, hard pack and soft serve, specialties, molded, decorated items and slices, desserts, puddings, frosted items, frappés, punches, bisques, lactose, mellorenes, non-dairy, frozen yogurts, popsicles, ice lollies, slushes, sorbets and others, and various combinations thereof. Ice confections may also contain optional ingredients such as fruit, nuts, chocolate, flour based products, *etc.* Within the general description of ice confections may also be included those products substantially similar in structure or function to ice confections, but which may not meet the specific legal definition(s) of ice confections in terms of their specific composition and/or process. Ice confectionery products include single serve items, such as on a stick, as well as those in a push up tube, or otherwise wrapped for easy consumption. Ice confectionery products may also be in the form of desserts, more or less elaborate for consumption at a table. Ice confections also serve to satisfy both nutritional, for example refreshment and hedonic needs, especially sweetness, of humans.

In order for ice confections to provide refreshment, they need to contain significant water, mostly as ice. Therefore, such products are not compatible with regular chewy candy or sugar confectionery, which is hydrophilic. There is a marked tendency for such combinations with regular candy to result in candy that absorbs water from the ice confection - with deleterious changes to both the candy and to the ice confection.

During the latter stages of the processing of ice confections, when combinations with other items such as chocolate, wafer, *etc.* are done, low temperatures are essential for reasons of shape, texture and microbiology. Such low temperatures are not appropriate for handling regular chewy candy or sugar confectionery because, at such temperatures the regular, chewy candy mass would not easily flow or otherwise be formable.

In order for ice confections to remain stable microbiologically as well as physically, they have to be at frozen conditions during their storage. They also are usually frozen throughout the vast majority of their consumption period to provide their cooling sensation and to maintain their physical shape and form. The ice confections will melt if stored at ambient conditions or if allowed to warm to ambient conditions prior to consumption. Therefore it is inevitable that chewy candy in a combination ice confection product will also be both

stored and consumed at a lower temperature than is normal for regular chewy candy. This has significant consequences for textural characteristics, including bite and mouthfeel, and also for flavor release characteristics.

5 In these respects, high water content, cold processing, cold storage and cold consumption temperatures, ice confections are not readily modified to become compatible with the chewy candy or sugar confectionery of prior art.

U.S. Patent No. 4,401,681 describes two-phase food products with reduced inter-phase moisture transfer. The technique is to incorporate dextrin and a hydrophilic polysaccharide gelling agent like pectin in amounts  
10 sufficient to form a barrier layer. It teaches a baking stage for the barrier layer to dehydrate and become impermeable. Such a baking stage is appropriate for dough-based goods such as cookies or pizzas, but clearly not for ice confections.

Further, U.S. Patent No. 4,401,681 teaches preventing moisture transfer  
15 from a chewy fruit material into drier, baked, dough-based products. In the case of chewy candy and ice confection combinations, the challenge is to prevent the chewy candy, possibly fruit-based from attracting moisture into itself, moisture coming from the ice confection. In other words, the moisture gradient is in the opposite direction.

20 In U.S. Patent No. 4,853,236, the achievement of a dual textured food piece containing a solid harder portion and a softer portion is taught. In this document, the softer phase could have up to a 0.2 difference in water activity from the harder phase. This was achieved by the use of oil-in-water emulsion in the soft portion, such that the emulsion was dimensionally stable at rest in  
25 being a thixotropic gel, which created a barrier between the portions.

The ice cream-types of ice confections are made from mixes which are of oil-in-water type, and the water ice types of ice confections do not contain significant levels of oil. In ice cream confections, the product is rapidly frozen, which converts fluid oils to solid fats, thus almost completely  
30 preventing oil mobility towards, and oil deposition at product interfaces. Therefore, the teaching of U.S. Patent No. 4,853,236 is inapplicable to composite food pieces in which one of the pieces is an ice confection, which is the softer phase. This is recognized in U.S. Patent No. 4,853,236 where benefits such as long term, unrefrigerated, shelf stability are described.

35 In WO 98/34499, the preparation of sheared gels containing agar, guar and locust bean gum is described in the preparation of ice cream, mousse and low fat spreads. Such a microparticulated gelling agent mixture led to claims to simulate the use of gelatin, such that the products had reduced syneresis or

weeping of fluids like water. This was believed to be caused by a postulated mechanism of gel recovery. Syneresis inhibition would seem a possible aid to inhibiting moisture transfer from ice confections to chewy candy items.

There is no combination, however, of the ice cream with chewy candy.

5 It is in the combination that the chewy candy exacerbates the moisture transfer by attracting water from the ice confectionery. Therefore, modifying ice cream according the teaching of WO 98/34499 does not prevent moisture migration in a composite product as contemplated here.

10 In U.S. Patent No. 5,718,931, simulated fruit pieces having moisture transfer resistance are described. In this system, the fruit pieces contain at least 45% humectant to inhibit their loss of moisture, and have a barrier coating comprising a surround of dried fruit particles and a gelatin-based gel layer. The aim of this patent is to create a water activity in the fruit pieces as low as 0.3 to 0.5 to inhibit moisture transfer from the chewy fruit materials to  
15 dry materials such as bran flakes in a packaged breakfast cereal.

The cereal of this patent normally attracts moisture from the chewy fruit analogue particles. In the case of chewy candy and ice confection combinations, however, Applicants note that the challenge is to prevent the chewy candy from attracting moisture into itself, moisture coming from the ice  
20 confection. In other words, the moisture gradient is in the opposite direction.

Despite the difficulties of achieving a chewy candy/ice confection combination, the human needs for both energy and for refreshment are not mutually exclusive - especially on days of hot weather. For added convenience, for variety and for hedonic delight, it is therefore desirable to  
25 have available single products that contain combinations of chewy candy and ice confections.

Thus, there remains a need for analogues of such chewy candy or sugar confectionery materials that are compatible with ice confections. A need exists for chewy candy that can be processed and stored in combination with ice  
30 confections. Also, there is a need for chewy candy that can be consumed in combination with ice confections at appropriate temperatures, without the chewy candy losing its desirable characteristics. The present invention teaches how to make and how to use chewy candy analogues, in combination with ice confections, without the aforementioned disadvantages.

35

#### SUMMARY OF THE INVENTION

The invention relates to a chewy candy or sugar confectionery analogue or to a food product containing the same. The analogue advantageously has an equilibrium relative humidity of at least about 70% and a chewy transition

temperature from about -15°C to 0 °C. Thus, the analogue is in a glassy state at normal cold storage and distribution temperatures for ice confectioneries but becomes chewy in the mouth when eaten cold, thus simulating the texture of regular chewy candy eaten at ambient temperature.

5        Suitable analogues include at least one ingredient of boiled sugar sweets, caramels, toffees, fudges, gums, jellies, licorice paste, cream paste, aerated confections such as marshmallow and nougat, chewing gums, fondants, marzipans. In a preferred embodiment, the chewy transition temperature of the analogue is from about -12°C to -3°C, and the equilibrium  
10        relative humidity is at least about 75%.

      The invention also relates to a process for preparing the product, wherein the ingredients are dispersed with water, cooked, and then diluted with an aqueous phase under sufficient pasteurization to achieve a fluid  
15        pasteurized mass having the equilibrium relative humidity of at least about 70%.

      Another aspect of the invention relates to a process for preparing a composite frozen confectionery product by combining the product with an ice confection, which includes rapidly cooling a fluid chewy candy mass by first contacting the mass with an ice confection having a temperature of less than  
20        about -15°C to form a combination, and conditioning the combination in a medium having a temperature of less than -15°C until the chewy candy mass has undergone a glass transition.

      The invention further relates to a composite frozen confectionery product including a candy or sugar confectionery analogue as described above,  
25        and an ice confection. In one embodiment, the ice confection is disposed on a stick or in a push-up tube. In another embodiment, the ice confection includes at least one of ice cream, pudding, yogurt, popsicle, slush, or sorbet. In yet another embodiment, the ice confection further includes at least one of chocolate, flour-based products, or a plurality of fruit or nuts.

30        It is preferred that the analogue is predominantly glass, *i.e.*, has less than half of its structure in crystalline form. In one preferred embodiment, the analogue is substantially free of crystalline structure. *i.e.*, less than 5% of crystalline structure. In another preferred embodiment, the analogue is completely free of crystalline structure, *i.e.*, is a complete glass.

35        In one embodiment, the analogue include at least one coloring agent. In another embodiment, the analogue includes at least one sugar, palm oil, and water. In a preferred embodiment, the at least one sugar includes sucrose and corn syrup and the analogue further includes mango pulp, pectin and citric acid. In a preferred embodiment, the total sugar is present in an amount of

about 60 to 90 parts, and the palm oil is present in an amount of about 2 to 8 parts. In yet another embodiment, the mango pulp is present in an amount of about 5 to 15 parts, the pectin is present in an amount of about 0.2 to 1.2 parts, and the citric acid is present in an amount of about 0.05 to 0.7 parts.

5

#### BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages of the invention can be ascertained from the following detailed description that is provided in connection with the drawing(s) described below:

10        FIG. 1 schematically illustrates a DMTA disc-bending sample holder for testing products prepared according to the invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200  
201  
202  
203  
204  
205  
206  
207  
208  
209  
210  
211  
212  
213  
214  
215  
216  
217  
218  
219  
220  
221  
222  
223  
224  
225  
226  
227  
228  
229  
230  
231  
232  
233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273  
274  
275  
276  
277  
278  
279  
280  
281  
282  
283  
284  
285  
286  
287  
288  
289  
290  
291  
292  
293  
294  
295  
296  
297  
298  
299  
300  
301  
302  
303  
304  
305  
306  
307  
308  
309  
310  
311  
312  
313  
314  
315  
316  
317  
318  
319  
320  
321  
322  
323  
324  
325  
326  
327  
328  
329  
330  
331  
332  
333  
334  
335  
336  
337  
338  
339  
340  
341  
342  
343  
344  
345  
346  
347  
348  
349  
350  
351  
352  
353  
354  
355  
356  
357  
358  
359  
360  
361  
362  
363  
364  
365  
366  
367  
368  
369  
370  
371  
372  
373  
374  
375  
376  
377  
378  
379  
380  
381  
382  
383  
384  
385  
386  
387  
388  
389  
390  
391  
392  
393  
394  
395  
396  
397  
398  
399  
400  
401  
402  
403  
404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416  
417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427  
428  
429  
430  
431  
432  
433  
434  
435  
436  
437  
438  
439  
440  
441  
442  
443  
444  
445  
446  
447  
448  
449  
450  
451  
452  
453  
454  
455  
456  
457  
458  
459  
460  
461  
462  
463  
464  
465  
466  
467  
468  
469  
470  
471  
472  
473  
474  
475  
476  
477  
478  
479  
480  
481  
482  
483  
484  
485  
486  
487  
488  
489  
490  
491  
492  
493  
494  
495  
496  
497  
498  
499  
500  
501  
502  
503  
504  
505  
506  
507  
508  
509  
510  
511  
512  
513  
514  
515  
516  
517  
518  
519  
520  
521  
522  
523  
524  
525  
526  
527  
528  
529  
530  
531  
532  
533  
534  
535  
536  
537  
538  
539  
540  
541  
542  
543  
544  
545  
546  
547  
548  
549  
550  
551  
552  
553  
554  
555  
556  
557  
558  
559  
560  
561  
562  
563  
564  
565  
566  
567  
568  
569  
570  
571  
572  
573  
574  
575  
576  
577  
578  
579  
580  
581  
582  
583  
584  
585  
586  
587  
588  
589  
590  
591  
592  
593  
594  
595  
596  
597  
598  
599  
600  
601  
602  
603  
604  
605  
606  
607  
608  
609  
610  
611  
612  
613  
614  
615  
616  
617  
618  
619  
620  
621  
622  
623  
624  
625  
626  
627  
628  
629  
630  
631  
632  
633  
634  
635  
636  
637  
638  
639  
640  
641  
642  
643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
671  
672  
673  
674  
675  
676  
677  
678  
679  
680  
681  
682  
683  
684  
685  
686  
687  
688  
689  
690  
691  
692  
693  
694  
695  
696  
697  
698  
699  
700  
701  
702  
703  
704  
705  
706  
707  
708  
709  
710  
711  
712  
713  
714  
715  
716  
717  
718  
719  
720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745  
746  
747  
748  
749  
750  
751  
752  
753  
754  
755  
756  
757  
758  
759  
760  
761  
762  
763  
764  
765  
766  
767  
768  
769  
770  
771  
772  
773  
774  
775  
776  
777  
778  
779  
780  
781  
782  
783  
784  
785  
786  
787  
788  
789  
790  
791  
792  
793  
794  
795  
796  
797  
798  
799  
800  
801  
802  
803  
804  
805  
806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822  
823  
824  
825  
826  
827  
828  
829  
830  
831  
832  
833  
834  
835  
836  
837  
838  
839  
840  
841  
842  
843  
844  
845  
846  
847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864  
865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887  
888  
889  
890  
891  
892  
893  
894  
895  
896  
897  
898  
899  
900  
901  
902  
903  
904  
905  
906  
907  
908  
909  
910  
911  
912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930  
931  
932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965  
966  
967  
968  
969  
970  
971  
972  
973  
974  
975  
976  
977  
978  
979  
980  
981  
982  
983  
984  
985  
986  
987  
988  
989  
990  
991  
992  
993  
994  
995  
996  
997  
998  
999  
1000  
1001  
1002  
1003  
1004  
1005  
1006  
1007  
1008  
1009  
1010  
1011  
1012  
1013  
1014  
1015  
1016  
1017  
1018  
1019  
1020  
1021  
1022  
1023  
1024  
1025  
1026  
1027  
1028  
1029  
1030  
1031  
1032  
1033  
1034  
1035  
1036  
1037  
1038  
1039  
1040  
1041  
1042  
1043  
1044  
1045  
1046  
1047  
1048  
1049  
1050  
1051  
1052  
1053  
1054  
1055  
1056  
1057  
1058  
1059  
1060  
1061  
1062  
1063  
1064  
1065  
1066  
1067  
1068  
1069  
1070  
1071  
1072  
1073  
1074  
1075  
1076  
1077  
1078  
1079  
1080  
1081  
1082  
1083  
1084  
1085  
1086  
1087  
1088  
1089  
1090  
1091  
1092  
1093  
1094  
1095  
1096  
1097  
1098  
1099  
1100  
1101  
1102  
1103  
1104  
1105  
1106  
1107  
1108  
1109  
1110  
1111  
1112  
1113  
1114  
1115  
1116  
1117  
1118  
1119  
1120  
1121  
1122  
1123  
1124  
1125  
1126  
1127  
1128  
1129  
1130  
1131  
1132  
1133  
1134  
1135  
1136  
1137  
1138  
1139  
1140  
1141  
1142  
1143  
1144  
1145  
1146  
1147  
1148  
1149  
1150  
1151  
1152  
1153  
1154  
1155  
1156  
1157  
1158  
1159  
1160  
1161  
1162  
1163  
1164  
1165  
1166  
1167  
1168  
1169  
1170  
1171  
1172  
1173  
1174  
1175  
1176  
1177  
1178  
1179  
1180  
1181  
1182  
1183  
1184  
1185  
1186  
1187  
1188  
1189  
1190  
1191  
1192  
1193  
1194  
1195  
1196  
1197  
1198  
1199  
1200  
1201  
1202  
1203  
1204  
1205  
1206  
1207  
1208  
1209  
1210  
1211  
1212  
1213  
1214  
1215  
1216  
1217  
1218  
1219  
1220  
1221  
1222  
1223  
1224  
1225  
1226  
1227  
1228  
1229  
1230  
1231  
1232  
1233  
1234  
1235  
1236  
1237  
1238  
1239  
1240  
1241  
1242  
1243  
1244  
1245  
1246  
1247  
1248  
1249  
1250  
1251  
1252  
1253  
1254  
1255  
1256  
1257  
1258  
1259  
1260  
1261  
1262  
1263  
1264  
1265  
1266  
1267  
1268  
1269  
1270  
1271  
1272  
1273  
1274  
1275  
1276  
1277  
1278  
1279  
1280  
1281  
1282  
1283  
1284  
1285  
1286  
1287  
1288  
1289  
1290  
1291  
1292  
1293  
1294  
1295  
1296  
1297  
1298  
1299  
1300  
1301  
1302  
1303  
1304  
1305  
1306  
1307  
1308  
1309  
1310  
1311  
1312  
1313  
1314  
1315  
1316  
1317  
1318  
1319  
1320  
1321  
1322  
1323  
1324  
1325  
1326  
1327  
1328  
1329  
1330  
1331  
1332  
1333  
1334  
1335  
1336  
1337  
1338  
1339  
1340  
1341  
1342  
1343  
1344  
1345  
1346  
1347  
1348  
1349  
1350  
1351  
1352  
1353  
1354  
1355  
1356  
1357  
1358  
1359  
1360  
1361  
1362  
1363  
1364  
1365  
1366  
1367  
1368  
1369  
1370  
1371  
1372  
1373  
1374  
1375  
1376  
1377  
1378  
1379  
1380  
1381  
1382  
1383  
1384  
1385  
1386  
1387  
1388  
1389  
1390  
1391  
1392  
1393  
1394  
1395  
1396  
1397  
1398  
1399  
1400  
1401  
1402  
1403  
1404  
1405  
1406  
1407  
1408  
1409  
1410  
1411  
1412  
1413  
1414  
1415  
1416  
1417  
1418  
1419  
1420  
1421  
1422  
1423  
1424  
1425  
1426  
1427  
1428  
1429  
1430  
1431  
1432  
1433  
1434  
1435  
1436  
1437  
1438  
1439  
1440  
1441  
1442  
1443  
1444  
1445  
1446  
1447  
1448  
1449  
1450  
1451  
1452  
1453  
1454  
1455  
1456  
1457  
1458  
1459  
1460  
1461  
1462  
1463  
1464  
1465  
1466  
1467  
1468  
1469  
1470  
1471  
1472  
1473  
1474  
1475  
1476  
1477  
1478  
1479  
1480  
1481  
1482  
1483  
1484  
1485  
1486  
1487  
1488  
1489  
1490  
1491  
1492  
1493  
1494  
1495  
1496  
1497  
1498  
1499  
1500  
1501  
1502  
1503  
1504  
1505  
1506  
1507  
1508  
1509  
1510  
1511  
1512  
1513  
1514  
1515  
1516  
1517  
1518  
1519  
1520  
1521  
1522  
1523  
1524  
1525  
1526  
1527  
1528  
1529  
1530  
1531  
1532  
1533  
1534  
1535  
1536  
1537  
1538  
1539  
1540  
1541  
1542  
1543  
1544  
1545  
1546  
1547  
1548  
1549  
1550  
1551  
1552  
1553  
1554  
1555  
1556  
1557  
1558  
1559  
1560  
1561  
1562  
1563  
1564  
1565  
1566  
1567  
1568  
1569  
1570  
1571  
1572  
1573  
1574  
1575  
1576  
1577  
1578  
1579  
1580  
1581  
1582  
1583  
1584  
1585  
1586  
1587  
1588  
1589  
1590  
1591  
1592  
1593  
1594  
1595  
1596  
1597  
1598  
1599  
1600  
1601  
1602  
1603  
1604  
1605  
1606  
1607  
1608  
1609  
1610  
1611  
1612  
1613  
1614  
1615  
1616  
1617  
1618  
1619  
1620  
1621  
1622  
1623  
1624  
1625  
1626  
1627  
1628  
1629  
1630  
1631  
1632  
1633  
1634  
1635  
1636  
1637  
1638  
1639  
1640  
1641  
1642  
1643  
1644  
1645  
1646  
1647  
1648  
1649  
1650  
1651  
1652  
1653  
1654  
1655  
1656  
1657  
1658  
1659  
1660  
1661  
1662  
1663  
1664  
1665  
1666  
1667  
1668  
1669  
1670  
1671  
1672  
1673  
1674  
1675  
1676  
1677  
1678  
1679  
1680  
1681  
1682  
1683  
1684  
1685  
1686  
1687  
1688  
1689  
1690  
1691  
1692  
1693  
1694  
1695  
1696  
1697  
1698  
1699  
1700  
1701  
1702  
1703  
1704  
1705  
1706  
1707  
1708  
1709  
1710  
1711  
1712  
1713  
1714  
1715  
1716  
1717  
1718  
1719  
1720  
1721  
1722  
1723  
1724  
1725  
1726  
1727  
1728  
1729  
1730  
1731  
1732  
1733  
1734  
1735  
1736  
1737  
1738  
1739  
1740  
1741  
1742  
1743  
1744  
1745  
1746  
1747  
1748  
1749  
1750  
1751  
1752  
1753  
1754  
1755  
1756  
1757  
1758  
1759  
1760  
1761  
1762  
1763  
1764  
1765  
1766  
1767  
1768  
1769  
1770  
1771  
1772  
1773  
1774  
1775  
1776  
1777  
1778  
1779  
1780  
1781  
1782  
1783  
1784  
1785  
1786  
1787  
1788  
1789  
1790  
1791  
1792  
1793  
1794  
1795  
1796  
1797  
1798  
1799  
1800  
1801  
1802  
1803  
1804  
1805  
1806  
1807  
1808  
1809  
1810  
1811  
1812  
1813  
1814  
1815  
1816  
1817  
1818  
1819  
1820  
1821  
1822  
1823  
1824  
1825  
1826  
1827  
1828  
1829  
1830  
1831  
1832  
1833  
1834  
1835  
1836  
1837  
1838  
1839  
1840  
1841  
1842  
1843  
1844  
1845  
1846  
1847  
1848  
1849  
1850  
1851  
1852  
1853  
1854  
1855  
1856  
1857  
1858  
1859  
1860  
1861  
1862  
1863  
1864  
1865  
1866  
1867  
1868  
1869  
1870  
1871  
1872  
1873  
1874  
1875  
1876  
1877  
1878  
1879  
1880  
1881  
1882  
1883  
1884  
1885  
1886  
1887  
1888  
1889  
1890  
1891  
1892  
1893  
1894  
1895  
1896  
1897  
1898  
1899  
1900  
1901  
1902  
1903  
1904  
1905  
1906  
1907  
1908  
1909  
1910  
1911  
1912  
1913  
1914  
1915  
1916  
1917  
1918  
1919  
1920  
1921  
1922  
1923  
1924  
1925  
1926  
1927  
1928  
1929  
1930  
1931  
1932  
1933  
1934  
1935  
1936  
1937  
1938  
1939  
1940  
1941  
1942  
1943  
1944  
1945  
1946  
1947  
1948  
1949  
1950  
1951  
1952  
1953  
1954  
1955  
1956  
1957  
1958  
1959  
1960  
1961  
1962  
1963  
1964  
1965  
1966  
1967  
1968  
1969  
1970  
1971  
1972  
1973  
1974  
1975  
1976  
1977  
1978  
1979  
1980  
1981  
1982  
1983  
1984  
1985  
1986  
1987  
1988  
1989  
1990  
1991  
1992  
1993  
1994  
1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003  
2004  
2005  
2006  
2007  
2008  
2009  
2010  
2011  
2012  
2013  
2014  
2015  
2016  
2017  
2018  
2019  
2020  
2021  
2022  
2023  
2024  
2025  
2026  
2027  
2028  
2029  
2030  
2031  
2032  
2033  
2034  
2035  
2036  
2037  
2038  
2039  
2040  
2041  
2042  
2043  
2044  
2045  
2046  
2047  
2048  
2049  
2050  
2051  
2052  
2053  
2054  
2055  
2056  
2057  
2058  
2059  
2060  
2061  
2062  
2063  
2064  
2065  
2066  
2067  
2068  
2069  
2070  
2071  
2072  
2073  
2074  
2075  
2076  
2077  
2078  
2079  
2080  
2081  
2082  
2083  
2084  
2085  
2086  
2087  
2088  
2089  
2090  
2091  
2092  
2093  
2094  
2095  
2096  
2097  
2098  
2099  
2100  
2101  
2102  
2103  
2104  
2105  
2106  
2107  
2108  
2109  
2110  
2111  
2112  
2113  
2114  
2115  
2116  
2117  
2118  
2119  
2120  
2121  
2122  
2123  
2124  
2125  
2126  
2127  
2128  
2129  
2130  
2131  
2132  
2133  
2134  
2135  
2136  
2137  
2138  
2139  
2140  
2141  
2142  
2143  
2144  
2145  
2146  
2147  
2148  
2149  
2150  
2151  
2152  
2153  
2154  
2155  
2156  
2157  
2158  
2159  
2160  
2161  
2162  
2163  
2164  
2165  
2166  
2167  
2168  
2169  
2170  
2171  
2172  
2173  
2174  
2175  
2176  
2177  
2178  
2179  
2180  
2181  
2182  
2183  
2184  
2185  
2186  
2187  
2188  
2189  
2190  
2191  
2192  
2193  
2194  
2195  
2196  
2197  
2198  
2199  
2200  
2201  
2202  
2203  
2204  
2205  
2206  
2207  
2208  
2209  
2210  
2211  
2212  
2213  
2214  
2215  
2216  
2217

The invention also concerns regular ice confection and chewy candy or sugar confectionery analogue combination products. These products have novel changes of character between their initial bite, and during their chewing up to swallowing.

5 Chewy candy or sugar confectionery products include certain boiled sugar sweets, caramels, toffees, fudges, gums, jellies, licorice paste, cream paste, aerated confections such as marshmallow and nougat, various tablets, lozenges, chewing gums, fondants, marzipans, and the like, and combinations thereof. A variety of ice confections suitable for use according to the  
10 invention are also well known. They include ice cream bulk products, novelties, *i.e.*, bar and stick items, hard pack and soft serve, specialties, molded, decorated items and slices, desserts, puddings, frosted items, frappés, punches, bisques, lactos, mellorenes, non-dairy, frozen yogurts, popsicles, ice lollies, slushes, sorbets and others, and various combinations thereof. Ice  
15 confections may also contain optional ingredients such as fruit, nuts, chocolate, flour based products, *etc.* Within the general description of ice confections may also be included those products substantially similar in structure or function to ice confections, but which may not meet the specific legal definition(s) of ice confections in terms of their specific composition  
20 and/or process. Ice confectionery products include single serve items, such as on a stick, as well as those in a push up tube, or otherwise wrapped for easy consumption. Ice confectionery products may also be in the form of desserts, more or less elaborate for consumption at a table. Ice confections also serve to satisfy both nutritional, for example refreshment and hedonic needs, especially  
25 sweetness, of humans.

The present invention includes equilibrium relative humidity (ERH) and chewy transition temperature, which is a special form of a glass transition temperature (or  $T_g$ ) measured at a high frequency of oscillatory deformation.

The first feature provides chewy candy or sugar confectionery  
30 analogues having an elevated equilibrium relative humidity (ERH) to inhibit or avoid moisture transfer from ice confections that are touching the candy analogues during the preparation, storage and consumption of products that are combinations thereof. ERH is not directly related to moisture content, but is  
35 influenced by the specific composition of the different soluble solids in the syrup phase of the candy analogue, as is known by those of ordinary skill in the art.

There are a number of methods for the determination of the ERH of candy, including for example, the method described by Norrish, R. S., (1964),

Confectionery Production, (10), 769, 771 and 808. ERH of a candy may be described as the relative humidity (RH) of the air, at which the candy does not gain or lose moisture.

When two food components (in this case the candy analogue and the ice confection) have similar equilibrium relative humidities (ERHs), the driving force for the movement of moisture between the articles is minimized. This is considered a direct moisture transfer route and if this were the only route of moisture transfer then direct barrier materials might help. There is also, however, an indirect moisture transfer route.

The absolute moisture content (humidity) in the atmosphere surrounding an ice confection during its storage at around - 30°C is relatively low. But, this does not mean that such atmosphere has a low relative humidity (RH). RH is the amount of moisture in the air, expressed as a percentage of the maximum amount of moisture that the air can hold at the same temperature (or when the dew point is that temperature).

To measure relative humidity below freezing point with a wet and dry bulb psychrometer, it is necessary to paint the wet bulb with distilled water and wait for a steady ice-bulb temperature to be reached. If the wet bulb gets coated with super-cooled water, freezing may be induced by touching the wet bulb with a piece of ice (or hoar frost). Upon freezing, the wet bulb will first rise to 0°C and, after freezing is completed, will gradually fall to give a true ice bulb reading. Sufficient time (30 minutes) should be allowed to attain a steady temperature before consulting hygrometric tables to determine the correct RH of the air.

The ice confections of the invention, despite their low moisture vapor pressure, will reach equilibrium with air (inside the wrapped package) during storage. This air is very close to its dew point (point of maximum moisture saturation), because the air is at the same low temperature as the ice confection, and the air therefore has very little moisture holding capacity.

During the fluctuations of temperature that occur during product storage and distribution, moisture is both vaporized from the ice confection into this air and then condensed out of this air in a cyclic manner. The saturated vapor pressure (SVP) over ice is well below 1 millibar at the normal (- 30°C) storage conditions of ice confections (SVP equals 1 mbar at - 21°C). This makes seemingly minor changes in the moisture content of the air exceedingly critical.

In the case of a combination product containing both a regular chewy candy and an ice confection, there is a natural partition of the condensing



moisture vapors. The moisture vapors condense to a higher extent upon the product with the lowest ERH (such as the regular chewy candy).

Importantly, the rate of absorption of the moisture is also a reaction that proceeds slowly at the low temperatures of cold storage. Therefore, any sudden changes in temperature can induce dew at a faster rate than can be accommodated by a chewy candy's moisture absorption rate. When this occurs there is a visual "sweating" with a resultant dissolving of water-soluble materials at the surface of the chewy candy. This undesirable situation leads to further problems in terms of appearance, color washing and growth of surface sugar crystals.

This "indirect" moisture transfer route has been discovered to be of major significance. For this reason, the mere provision of a moisture barrier layer between the chewy candy and the ice confection is ineffective. The alternative of totally wrapping the chewy candy in a moisture barrier, such as a fat system like chocolate, is a little more effective - but this can distract from both the visual appeal and the textural sensations upon product consumption.

Another consideration is that moisture barriers frequently become brittle at the cold storage temperatures of ice confections, and are subject to cracking during the expansions/contractions induced by any unplanned thermal fluctuations. The integrity of barriers therefore cannot always be guaranteed.

It has been discovered that chewy candy analogues for the purpose of this invention may be formulated with their ERH substantially elevated. The ERH of regular chewy candy normally lies in the region of 45% to 65% depending upon type and specific recipe. For a table of ERH for different chewy candy type, see Lees R., and Jackson, E.B., (1973), "Sugar Confectionery and Chocolate Manufacture", Leonard Hill Books, 8.

In particular, the chewy candy product analogues of the present invention are provided with an elevation to at least about 70% in ERH, and preferably at least about 75% in ERH. Such an increase in ERH is a vital first step in minimizing the problems of moisture transfer when combining chewy candy and ice cream. To achieve such a high ERH, the formulation of the chewy candy analogue is modified both by recipe and by process.

The ERH of the recipe is inversely proportional to the molecular concentration of the dissolved components in the syrup phase. A reduction in molecular concentration will increase the ERH. Therefore, any relatively low molecular weight elements such as salts and polyols (glycerol, sorbitol, *etc.*) should be reduced in their quantity. The grade of any corn syrup can also preferably have its dextrose equivalent (DE) reduced to take advantage of

higher molecular weights. The low DE corn syrup solids will also introduce a beneficial skin generation characteristic. High molecular weight materials such as hydrocolloids may replace part of the regular solid contents that are lower in molecular weight. Similarly, the generation of polymers *in situ* during processing (such as the caramelizing of simple sugars) can be advantageous.

In terms of process, the cooking temperatures should be reduced to minimize dehydration. Alternatively, lost moisture should be re-incorporated after cooking should high temperatures be desirable for other reasons, such as protein modification.

There are other benefits in having the chewy candy analogue at a higher ERH. The viscosity of the hot mass is lower, which enhances convection type heat transfers thus improving the efficiency of cooking. Further, the lower viscosity mass has improved flow properties for processing without having to resort to the elevated temperatures of conventional chewy candy handling.

Such an increase in ERH would clearly be detrimental to the microbiological aspects of the ambient storage and distribution of regular chewy candy. This is not a concern, however, in the deep freeze cold storage and distribution of the pasteurized chewy candy analogues of the present invention.

Such an increase in ERH would also significantly and detrimentally soften prior art chewy candy in terms of its textural characteristics at ambient conditions. This would tend to result in undesirable cold flow problems (a slow deformation of shape) and excessive wrapper adhesion of such conventional chewy candy.

Surprisingly, the chewy candy analogue products of the present invention do not have excessive softness. It will be noted that the chewy candy analogues of the present invention would differ in textural characteristics compared to conventional chewy candy if both were evaluated at ambient temperature. An important consideration in the present invention, however, is that it is the textural characteristics of the chewy candy analogues at their temperature when combined with ice confections that are relevant. It is the texture generated, when eaten cold, that should simulate the texture of regular chewy candy when eaten at ambient temperature.

In part, the reduction in softness of the present invention is achieved because the chewy candy analogues of the present invention are stored, distributed and consumed at much lower temperatures.

Another preferred feature of these chewy candy analogues according to the invention is to create a different chewy transition temperature point for the chewy candy analogues versus regular chewy candy. The desired chewy transition temperature for the chewy candy analogues of the present invention is from about -15°C to 0°C, and preferably from about -12°C and -3°C.

A chewy transition is a special form of a glass transition temperature that is a change in the structural state of the matter from a glassy (non-crystalline) solid that fractures upon deformation, to a more flexible solid structure that may be deformed without fracture resulting.

In the apparently solid glass, the random molecular structure of a liquid sol remains, yet the cross-link density (particularly with polymeric molecules) prevents large-scale molecular motion and so leads to the properties of brittleness, stiffness and rigidity.

A glassy solid may be differentiated from a crystalline solid, and a glassy solid has benefits over a crystalline solid in this invention. In contrast to a glassy solid, a crystal solid exhibits specific X-ray diffraction or other light scattering patterns owing to the regular repeating pattern of its molecules. A glass does not exhibit this property.

Glass transition points in general may be measured by a variety of methods, one example being the use of differential scanning calorimetry (DSC). Other techniques may include determining the temperature at which there is a loss of dielectric molecular motion, or by monitoring the changes in loss or elastic moduli ( $G''$  or  $G'$ ) during a temperature sweep in oscillatory or oscillation type rheometry. Differential scanning calorimetry (DSC) measures one type of glass transition point ( $T_g$ ). For DSC, the sample is very cold and warmed slowly until the very first molecular movement starts to occur. This event exhibits itself as a small but measurable change in enthalpy.

There are other "glassy types" of transitions that occur at other temperatures. The transition temperature at which a glassy material converts to a deformable chewy solid is related to the frequency of the applied deformation. To explain this aspect one may consider a glass window. One knows that even a glass window in an ancient cathedral (say 500 years old) will be thicker at the bottom than at the top. Such cathedral glass has exhibited deformation (in that it flowed under gravity) - because sufficient time passed for the movement (or in other words it experienced a very low frequency of deformation). Under a larger frequency of deformation, the cathedral glass would have behaved as a fracturable solid and would have shattered.

During the process of eating foods, the frequency of deformation is relatively high compared to the frequency of deformation caused by gravity sag in a cathedral window. Therefore, the chewy candy or sugar confectionery of this invention tends to exhibit all the physical characteristics of being glass when below the chewy transition temperature, despite such materials having their chewy glass transition temperature above their DSC glass transition temperature.

It was discovered that the relevant temperature of this specific glass transition - corresponding to the appropriate sensory change experienced upon eating (the change from an apparent glassy solid to a mobile chewy mass) - could be accurately measured by the technique of Dynamic Mechanical Thermal Analysis (DMTA). An example method for the determination of this relevant and specific glass transition (termed the "chewy transition" temperature) by the technique of DMTA is supplied herein.

Considering and modeling certain physico-chemical properties of ingredients enables a prediction of the trending effects of the different recipe components upon this specific chewy type of glass transition point. Such properties include the connectivity basis of each functional group, likely molecular mechanical volume changes with temperature, and a general consideration of aspects such as the ease of the backbone rotation of polymers *etc.*

To achieve the desired chewy transition point, the chewy candy analogues are first prepared into a viscous solution state, which may include a degree of melting of some of the components, and which may also include some undissolved ingredients in suspension. The viscosity is achieved either by water content reduction, or by the addition of water binding elements such as hydrocolloids, especially where water content reduction alone would lower the ERH below the critical values at which the invention performs.

While in such a state of solution, albeit viscous, the molecules of the solution are disordered. When this viscous solution is contacted with and cooled with the frozen ice confection, it rapidly adopts a solid nature. During this event, the viscosity inhibits or even prevents the otherwise natural (based upon lowest energy interactions between the molecules) re-arrangement of the molecules into the form of a crystal lattice. The resultant solid-like structure is therefore a glass. This glass maintains a primarily random orientation of its molecules, yet is without noticeable flow properties. Without wishing to be bound by theory, the nature and concentration of the solutes, and the rapid increase in viscosity (to greater than about  $10^{12}$  Pa\*s at the temperature of

transition) are believed to be responsible for the maintenance of the amorphous nature of the solid-like glass.

It was discovered that achieving this particular glass transition could be achieved by contacting the chewy candy with an ice confection colder than about  $-15^{\circ}\text{C}$ , and then cooling the combination product in a medium having a temperature below about  $-15^{\circ}\text{C}$ . The so-induced glass transition serves several purposes and gives many benefits as noted herein.

The relatively high latent heat of fusion that would be released upon crystallization of the chewy candy analogue is inhibited or avoided.

Therefore, the effect of such a high latent heat upon the ice confection is also inhibited or avoided.

The thermal conductance of a glass is relatively low compared to a crystalline structures. Therefore, upon contacting the chewy candy analogue with the ice confection, an immediate insulation layer is formed and the vast majority of the heat loss is into the cooling chamber, not into the ice confection. In one embodiment of the invention, a highly viscous liquid chewy candy analogue at  $200^{\circ}\text{C}$  was contacted with ice cream at  $-25^{\circ}\text{C}$ , and the combination then cooled. A glass instantly formed at the interface, yet the ice cream surface advantageously did not visibly melt. The glass has a high clarity, providing the combination products significant visual appeal, which is desirable in the end products available to consumers.

The glass may contain colors or dyes that are substantially uniformly or completely uniformly distributed. In comparison, crystals are generally individually of high purity and upon crystallization from solution any prior incorporated color becomes concentrated and located at the crystal surfaces.

The glass tends to maintain its shape and solidity while in contact with the ice confection (until it is consumed and its glass transition temperature is then reached).

The low storage temperatures normal to ice confections inhibit the potential for graining or crystallization of the glass (to reach a lower energy state) during storage. The low temperatures inhibit or avoid achievement of the required activation energy of such a reaction, and additionally inhibit or avoid reaching reaction rates. This avoids the need to utilize low storage RH values to inhibit graining. This further permits the chewy candy analogues of the present invention to be in contact with ice confections throughout storage and distribution.

At the start of consumption, the glass tends to be brittle and so easily fractures, which gives a desirable clean bite to the combination of the chewy

candy analogue and the ice confection. Once bitten, the glass then transforms in the mouth. This is only partly because of elevated temperature. Another effect of solubility comes into play. The random orientation of the molecules in a glass causes them to be much more easily penetrated by moisture and hence more rapidly soluble than crystals would be upon consumption. Therefore, dilution rapidly changes the concentration of the glass and facilitates consumption of the combination product.

Dilution may be by saliva, the generation of which can in part be promoted by the incorporation of components such as acids or salts into the formulation of the chewy candy analogue. Additionally, dilution occurs by moisture released from the melting of the water content in the ice confection, which is being simultaneously consumed.

The glass transition point is lowered as the concentration of the material is lowered. Therefore, the original glass of the chewy candy analogue rapidly transforms into a new state which is herein referred to as the "rubbery phase." Once in the rubbery phase, the chewy candy analogue loses its glassy nature and the classic chewy nature of a regular chewy candy is restored.

While in either the glassy state or the rubber phase, the random orientation of the molecules of the chewy candy analogue permits intermingling and affinity of flavor compounds. This desirably results in a pleasant and prolonged release of flavor during product consumption.

In contrast, had the chewy candy analogue been present in a crystalline state, the purity of the individual crystals would have concentrated the flavor elements at the crystal surface. Consumption of a crystalline product would therefore have resulted in a rapid and perhaps overly strong initial flavor release associated with an undesirable and rapid flavor fade that consumers dislike.

The combined product of the invention may be in the form of an ice cream stick bar, which can be extruded or molded. Such a bar can be coated, on part or on its whole surface, with one or more layers of a chewy candy analogue of the invention. Coating may, for example, be made by enrobing or dipping. It can be accomplished by simple or multiple applications or layers of the analogue. The combined ice cream stick bar may also comprise a core of chewy candy analogue surrounded by an ice cream mass and can be made by the "shell and core" method known to those of ordinary skill in the art. Indeed, the chewy candy analogue can be used to form a plurality of inclusions in the ice confectionery, alternatively or in addition to either of the two above

embodiments. In one embodiment, the chewy candy analogue may be present as one or more inclusions in a mass of ice cream bulk or cup.

The combined product of the invention may be in the form of a morsel or ice cream bonbon coated or enrobed with a chewy candy analogue.

5 It may be a dessert, *e.g.*, in the form of a dome or cake that contains the chewy candy analogue as a coating, as a core, or as inclusions.

The chewy candy analogue may further be applied in successive layers or patterns between ice cream layers, *e.g.*, in a layered cake or log.

10 The combined product may further be coated or enrobed or otherwise combined with a fat-based coating, *e.g.*, a chocolate or couverture coating.

#### Method of Determining Chewy Transition Point by DMTA Measurement Experimental details

15 The viscoelastic properties are preferably measured by oscillatory bending using the Polymer Labs DMTA (distributed by Rheometrics Scientific International, Piscataway NJ 08854, USA). A disc-bending sample holder is used to contain the samples during the measurements. The DMTA disc-bending sample holder is shown schematically in FIG. 1. The sample holder consists of three aluminum rings 2, 3 and 4, separated by two plastic discs 5 and 6 (PET or KAPTON, 0.07 mm thick). The middle ring 3 (50 x 38 mm in diameter) of a thickness of 2 mm defines the sample 7 thickness for the measurements. This can be increased if samples are too soft. Even liquid samples are held in place by the two plastic discs 5 and 6 during the temperature scans.

25 The four legs (not shown) of the Polymer Labs DMTA pass through the rings. The rings are rigidly attached to these legs by nuts above and below the rings (not shown), thus clamping the plastic discs 5 and 6 tightly between the rings, and preventing leakage (a small amount of vacuum grease can be used as necessary).

30 The DMTA oscillatory force is applied to the centre of the plastic disc - sample "sandwich" via an M4 bolt 8 which passes through the plastic sheets which are separated there by an aluminium 6 mm diameter bushing 9 (to maintain a 2 mm sample thickness). Nuts 10, 11 tightened on washers 12 above and 13 below the plastic discs 5, 6 give rigid coupling to the DMTA drive shaft 14 (O-rings cannot be used here, as they have an observable glass transition in the range of -50°C). The DMTA head is positioned with the drive shaft 14 aligned vertically. The sample holder is below the head, in the

35

horizontal plane, to avoid gravitational effects during freezing, and to make quench cooling by immersion in liquid nitrogen possible.

It is important to note that the plastic discs 5 and 6 permit free movement of the sample centre of the order of + or - 2 mm. This is much greater than the deflection applied to the sample centre during the measurements ( $\pm 0.032$  mm). This corresponds to a strain of approximately 0.2%, which is well within the linear viscoelastic range, where the viscoelastic moduli have no strain dependence.

Two thermocouples (K type, not shown) are inserted, after the loading of samples, for in-sample temperature measurement during the temperature scan. A third thermocouple (not shown) in the rings is used to create a Differential Thermal Analysis (DTA) signal, for confirmation of glass transitions.

#### Sample loading procedure for the oscillatory disc-bending measurements

The 2 mm thick samples were removed from storage at  $-20^{\circ}\text{C}$ , allowed to warm to about room temperature (20 minutes) and then were spread over the bottom plastic disc 6, inside the center ring 3. The spacer bushing 9 was centered over the hole in the middle of the disc, and the top plastic disc 5 was positioned and pressed over the sample 7 and ring. Afterwards, the top clamping ring 2 was set in place, and the complete sample "sandwich" was held together by two screws. After insertion of the center bolt 8, the entire system was bolted to the legs of the DMTA. The nuts 10, 11 on the center bolt 8 were tightened onto the spacer bushing 9 and the center bolt 8 was clamped to the DMTA drive shaft 14. Before clamping, it is important to ensure that the center bolt 8 can move up and down freely.

#### Measurement and analysis

The viscoelastic moduli were measured in bending using a deflection of  $\pm 32$  microns, which corresponds to a strain of about 0.2%, which is low enough for the moduli to be measured in the linear viscoelastic range. The temperature of the chewy glass transition (onset of chewiness) is determined from the loss modulus peak temperature at a frequency of 100 Hz. (this temperature agrees with the sensory determination of onset of chewiness measured by surface infrared thermometer). At this chewy glass transition temperature the sample material functions as a "shock absorber" under the imposed deformation frequency.



The frequency of measurement may be multiplexed between other Hz values, while the temperature of the sample was being scanned continuously. Temperature scans were performed in cooling mode at 0.5°C/minute down to -80°C and in heating mode at 0.5°C/min. up to 40°C. The data was logged using Lotus 1-2-3 Measure program and analyzed using Lotus 1-2-3 and Excel. The DMTA disc bending technique gives a well-defined loss modulus peak temperature owing to the presence of the plastic discs that prevent the sample from flowing away when the transition temperature has been reached. A theoretical experimental artifact of measuring the rigidity of the plastic discs was not found to affect the determination of the onset of chewiness temperature. This is because the plastic disc rigidity only starts to become a feature when the sample material falls below a viscosity of 10<sup>3</sup> Pa\*s, (which only occurs well after the chewy transition).

## EXAMPLES

The invention is further illustrated, but not limited, in the following working examples, where all percentages and parts are by weight.

### Example 1: Glass-State Product Prepared According To The Invention

The following was prepared according to the invention as described below.

#### **Ingredients (by part)**

Sucrose	63
Corn syrup, 36 DE	16
Mango Pulp	10
Hydrogenated Palm Kernel Oil	5
Pectin, 35 DM*	0.7
Citric Acid	0.3
Water	16
Colors	q.s.
Flavors	q.s.
Total	111**

\* DM: Degree of Methylation

\*\* water was added after the color, flavor and acid addition to bring the total back to 100 parts.

90% of the total quantity of sucrose was dissolved in the water and brought to the boil. Corn syrup and hydrogenated palm kernel oil were added. The pectin was dry dispersed in 10% of the total quantity of sucrose and added using high speed agitation. The mix was heated rapidly to 124°C within 8 min. and then the mixture was rapidly cooled to 93°C within 10 min. Fruit pulp, acid, colors and flavors were added. The mix was adjusted back to 100 parts by water addition.

Temperature was maintained by use of a Dewar flask (vacuum insulated flask). Equilibrium relative humidity (ERH) was determined as 79% by using a water activity meter. Chewy transition temperature was determined as -9°C by stated DMTA technique. The fluid chewy candy analogue was contacted with ice cream mass at -25°C by applying surface stripes to the ice cream (it was a classical ice cream of 10% fat content and 60% overrun).

The combination product was cooled in a blast tunnel using air at -40°C until the external surface temperature of the product had reached -20°C as determined by infrared thermometer. The product was stored at -30°C as is normal for ice confections.

Upon consumption of the product, the glass and ice cream bit cleanly and the glass then rapidly converted to a chewy candy mass in the mouth.

#### Example 2 : Stick Ice Cream Product According To The Invention

A chewy candy analogue was prepared as in Example 1. The fluid chewy candy analogue was contacted with ice cream (on a stick) by dipping the ice cream (at -20°C) into an insulated reservoir containing the analogue to achieve a full surface coating. The combination product was cooled by placing in a liquid nitrogen medium, until the external surface temperature had reached -20°C. The product was then stored at -30°C. Upon consumption, the product had the same characteristics as that of example 1.

#### Example 3: Excess Solid Product According to the Invention

The following was prepared according to the invention.

Ingredient	%
Corn Syrup, 36 DE	17
Gelatine solution (20% of 150 Bloom)	9
Hydrogenated Palm Kernel Oil	4
Powder Sucrose	70
Colors	q.s.

Flavors	q.s.
Total	100

5 The corn syrup was heated to 60 °C. Hydrogenated palm kernel oil was added to the corn syrup, whereupon it melted and was dispersed. The gelatin solution was added and sucrose was added slowly with good agitation to avoid formation of lumps. The resultant mass was adjusted to an ERH (in the syrup phase) of 80%. The ERH was directly controlled by the composition of the syrup phase. The sucrose equivalent content of the syrup phase may be calculated from the total yield of the recipe according to the modified Grover's equation - Lees R., Jackson, E.B. (1973), "Sugar Confectionery & Chocolate Manufacture", Leonard Hill Books, 349. The syrup and crystal phase may also be calculated according to Hinton's equation - Hinton, C.L., (1958) "Manufacturing Confectioner", June - after determining the total dissolved solids of the syrup phase of the sample by, *e.g.*, refractometer.

15

- Only minor adjustment was necessary as a standardization step.
- The product was not pasteurized.
- The chewy transition temperature was determined to be at -8 °C initially, and did not change after 4 weeks storage at -30°C.

20 The fluid paste-like candy analogue mass was contacted as 1 mm thick layer with ice cream (-20°C) and the combination product was dipped in liquid nitrogen until the external surface temperature reached -20°C. The chewy candy analogue formed a glass interspersed with fine fondant-like sugar crystals. The combination product was stored at - 30 °C.

25

Upon consumption of the combination product, the candy mass moistened rapidly in the mouth and became chewy within 1-2 s.

This example demonstrated that even an excess of solids (a potential seed for crystallization) did not prevent a partial glass from forming when the cooling rate was sufficiently rapid.

30

### Comparative Example 1

An ice cream on a stick (as per example 2) was manually wrapped in fruit leather of the name "Fruit by the Foot," General Mills Inc., Minneapolis, MN55440, USA, a commercial product that is sensorially chewy when stored and consumed under ambient conditions. The combination product was stored at -30°C as is typical for ice cream. ERH and chewy transition were:

35

- ERH 57 %

- Chewy transition +10°C.

Upon attempting consumption, the now tough, conventional candy was not easily bitten, but rather slid from the ice cream in one piece. A knife was therefore used to prepare a mouth-sized portion of the combination product. Upon consumption the hard candy proved excessively adhesive to the teeth. The eating was laborious and the ice cream had completely melted 4 min. before the candy had achieved a desirable chewy texture.

#### 10 Comparative example 2

A regular pectin jelly candy was prepared according to the recipe as described in "Confectionery Products with Genu Pectins", 1986, A/S KØBENHAVNS PECTINFABRIK, The Copenhagen Pectin Factory, DK 4623, Little Skensved, Denmark, 7-10. This recipe is well known to give acceptable products for consumption – when as individual chewy candy items at ambient temperature. ERH and chewy transition were:

- ERH 61%
- Chewy transition +9°C

When the pectin recipe (at 90°C) was contacted with the ice cream (at -0 °C) by various means, adhesion was poor. Melting of the surface of the ice cream also occurred. During cold storage (-30°C), the chewy candy portion was observed to sweat and to bleed color. During consumption, the chewy candy was excessively hard and the ice cream had melted three minutes before the candy portion had become sufficiently pliable.

It is to be understood that the invention is not to be limited to the exact configuration as illustrated and described herein. For example, it should be apparent that a variety of materials would be suitable for use in the composition or method of making the golf balls according to the Detailed Description of the invention. Accordingly, all expedient modifications readily attainable by one of ordinary skill in the art from the disclosure set forth herein, or by routine experimentation therefrom, are deemed to be within the spirit and scope of the invention as defined by the appended claims.